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TOWARDS A KNOWLEDGE SOCIETY: THE PORTUGUESE CASE

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ABSTRACT

Economies are moving towards competitive stadiums based on knowledge and innovation. The changing environment and the level of globalization demand important efforts in order to sustain competitive advantages. Portugal has experienced a remarkable evolution since its adhesion to the European Union in several fields: economic development, Research & Development (R&D) consolidation, health parameters and social cohesion.

As other developed economies, Portugal started its journey towards a knowledge-based economy and has been consolidating an innovation system during the last 35 years. The following report aims to analyze the evolution of a system since its creation to its last transformation within a globalized context. Challenges such as the lack of maturity of the system, the economic crisis, the European paradox, and closing the gap with other European countries are addressed in the next chapters. Likewise, recommendations on these points are provided by the end of the report as potential solutions.

Key Words: Innovation, Competitiveness, Research, Development, Science, Portugal.

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1. Introduction

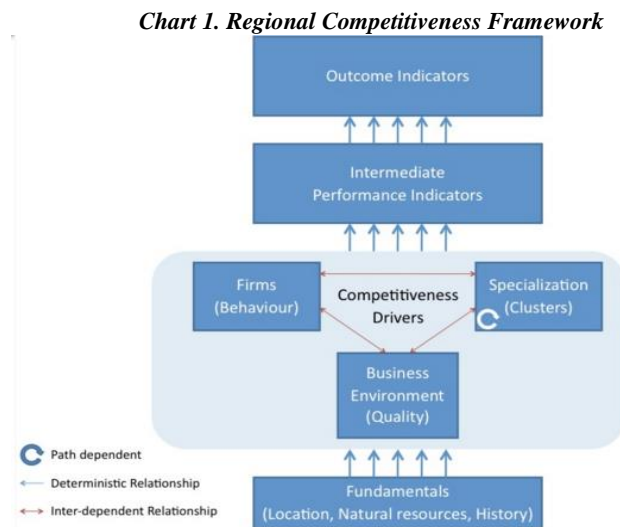
Globalization has changed and is changing the way countries interact and how they create competitive advantages. Besides this, the most recent crisis brought and boosted relevant productive transformations in several developed countries as a way to overcome it and move towards a knowledge-based economy in a faster pace. The knowledge society and innovation based economies are competitive stadiums where developed countries are moving forward to. According to the World Economic Forum, “(...) *Innovation is the key to a competitive and growing economy, unlocking major productivity gains and allowing companies to move towards higher value-added activities*” (WEF, 2015)

However, the performance and outcome indicators on this matter do not reflect the efforts and resources invested during the last decades in Europe. Even if some countries stand out as top innovators worldwide, Europe is struggling to translate its scientific and research advances into marketable products. This phenomenon is known as the *European Paradox* and constitute one of the most challenging obstacles to achieve the competitive stadium of innovation.

Since its adhesion to the European Union (EU), Portugal has experienced several changes in its productive system. Its economic growth has been remarkable and became a reference in specific industries. Nonetheless, it was not enough to close the gap with the leading innovators countries in the region.

This report aims to analyze and provide insights on the Portuguese case and its journey towards a new competitive stadium. For this purpose, the *Regional Competitiveness Framework (RCF)* developed by the European Cluster Observatory (ECO) will be the bottom line for the analysis as its composition allows us to have a holistic view of the system. This framework, as it can be seen

in *Chart 1*, organizes the different factors that influence the economic activity in four layers, the two top layers measure the final and intermediate outcomes, the bottom layer measures the fundamentals of the economy and the third layer is focused on measuring the competitiveness drivers. The third layer is the most important of the framework since it is where the policies have an impact in. For the following report, it is assumed that the output and intermediate indicators are the result of specific policies that interact with fundamental factors as the ECO has stated in 2010. This is complemented by *Orkestra – Basque Institute of Competitiveness* that recognizes a correlation between the outcome indicators and the innovation system which is the result of the interaction of the competitiveness drivers and the fundamental factors. (Orkestra, 2011).



Source: Orkestra, 2013

Therefore, the report is focused on describing the evolution of the Innovation System which comprehends the first two layers of *Chart 1* within three specific time periods: 1985, from 1986 to 2012 and from 2013 onwards. Some intermediate indicators such as patent applications, scientific production and high tech exports will be used to confirm the evolution of the system. However, measuring the impact and correlation between the evolution of the system and the outcome indicators such as GDP, labour productivity and human development will not be part of this paper.

The time periods represent completely different scenarios for the National Innovation System in Portugal. Before its adhesion to the EU, Portugal had a long dictatorship therefore the first time period -1985- allows us to know how Portugal was performing in terms of innovation before its integration to the EU and during the first years of transition towards democracy. Besides this, whenever data is available for some indicators, 1985 constitutes the point of reference to understand the evolution of the system derivate of the integration process and the convergence patterns. The next time period –1986 to 2012– comprehends the three main reforms to the Innovation System (1992, 2005 and 2012) and the implementation of the different operational programs and the community frameworks. This time period is characterized by the effort in closing the gap with the European countries and reflects the impact of 25 years of integration.

Finally, the last period represents a turning point to the system due to the economic crisis and the design of Portugal 2020 as vehicle to overcome the European Paradox and lead Portugal towards a knowledge-based economy. As it was mentioned before, the indicators were selected based on their relevance for the analysis, their linkage with the three competitive drivers –Firms, Business Environment and Specialization- and the availability for the time periods proposed for the report.

As Portugal is not the only country facing this process, four European countries have been chosen for the benchmark exercise: Spain, Italy, Norway and Finland. These countries were selected taking into account the *Innovation Union Scoreboard 2015*, prepared by the European Commission, which classified in four groups the EU Member States according to their performance in innovation. These groups are: Innovation leaders, Innovation Followers, Moderate Innovators and Modest Innovators. Spain and Italy are classified in the same group with Portugal as Moderate Innovators. On the other hand, Norway and Finland belong to the Innovation leaders group (European Union, 2015).

The report concludes with some recommendations on the National Research & Innovation System, its structure and the dynamics between its agents. These recommendations are aligned with Europe 2020 and propose some activities in order to get out of the Paradox and contribute to become a leading innovator country in Europe.

2. Science and Technology: The R&D system by 1985

The end of the dictatorship in 1974 brought a new process of openness to Portugal. Its adhesion to the EU represents the boldest step on its journey of economic and political development. The following chapter aims to analyze and state the position of Portugal by 1985 in several aspects: socioeconomic, political and how was performing in terms of innovation and competitiveness.

Portugal is a small country in terms of territory and population. Located in the western side of the Iberian Peninsula, Portugal has an area of 92.2 thousand km² and an exclusive economic zone of 18 times its area. By 1985, Portugal had 9.8 million of habitants and a GDP per capita of 9,000 Euros at current prices of 2011 (Pordata, 2015). The economy was mainly based on agriculture production with lack of infrastructure and equipment. Besides this, Portugal had a low rate of qualified workforce and competitiveness due to the state of underdevelopment of its productive system.

An analysis of the competitive drivers' indicators shows an expenditure in R&D lower than 0.5% of the GDP which is definitely below the EU27 average of 1.8% (ADI, 2015). Likewise, just 14% of the companies had employees with tertiary education and there were less than two researchers per thousand labour force.

At that time, the research was mainly focus in areas such as nuclear energy, public health, mineral exploitation, delineation of the overseas territories, tropical medicine, mapping natural resources

and industrial technologies (FCT, 2013). The focus on national missions reflects a mismatch with the business needs due to the lack of independency and the inexistence of a specific R&D policy. Before investing in R&D is important to generate the required infrastructure as it is proposed by the OECD, otherwise there is no efficiency within the innovation system.

On the other hand, research by the private sector was minimal due to the major role the Government had. The public R&D grouped more than 62% out of total researchers in Portugal and its expenditure reached the 45% out of the total R&D Expenditure (FCT, 2013). In contrast, the majority of developed countries were trying to reduce their public participation in the R&D Expenditure and motivate business to take part of the system. Finally, Higher education had a limited relevance within the system as it only represented 14.6% out of the total expenditure. This situation was not exclusively of Portugal, other southern European countries like Spain and Italy had the same situation as it is normal in an initial phase.

As it can be concluded, the National Research and Innovation System (NRIS) was mainly driven by the Public sector not only in terms of funding but also from the supply and demand side. The capabilities were built without having a specific plan, responding to temporary needs or governmental missions as the organization chart shows in *Appendix 1*.

The implementation of the NRIS was extremely linked with the governance model and the country's idiosyncrasy at that time, thus, recommendations from the OECD like a system independent and autonomous from cultural and educational policies, an horizontal coordination, medium term plans with foresight activities, the creation of a specific Budget for R&D and a competitive allocation of resources were adopted only much after and the system was dependent on one government member from the mid-80s onwards. Despite of the creation of the National Board for Scientific and Technological Research as a coordination body within the system in 1985,

the policy cycle remains at intermediary level where funding and advocacy were the main tasks assigned.

Thus, by the moment before its adhesion to the EU, Portuguese innovation system was mainly driven by the Government both in fields of R&D and funding. The national expenditure was below the average and there was not an independent coordination body to promote research not only in academic scenarios but also in small and medium size businesses. By 1985, Portugal started adapting its NRIS due to the community convergence patterns but cultural biases did not allow an early implementation of OECD recommendations which increased the gap between Portugal and the most advanced economies in Europe.

3. Closing the Gap: building innovative capabilities (1986 – 2012)

Since its adhesion to the EU, Portugal experienced a long term of development and growth. The structural funds allowed Portugal to invest and close the gap with its European partners. There is no doubt on the evolution and a vast range of indicators confirms the transition to a competitive stadium of productiveness and investment. Having some fundamental factors already well established, Portugal was focused on developing the competitive drivers such as infrastructure, education, industrial policies and the internationalization of its economy.

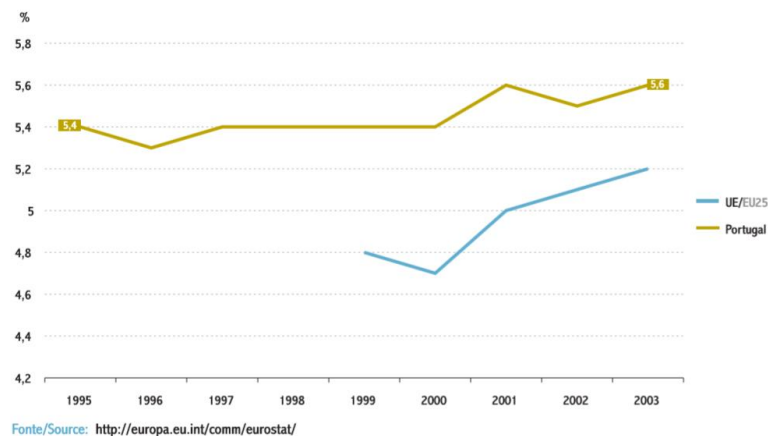
The first twenty years as member of the EU can be recognized by a deep investment in building capabilities (supply side) and the transition from an economy mainly driven by agriculture to an industrial economy with a diversified composition. As it will be discuss later in this chapter, Portugal recognizes and start taking advantage of the rising specialization of the regions and the cluster dynamic due to geographic and cultural aspects.

On the other hand, there was a clear alignment with the European members in areas such as life quality, business environment and governance. Thus, Portugal became relevant for Europe as a country that contributes to a common purpose within the most successful integration project of the recent history. This chapter aims to analyze the evolution of Portuguese National Innovation System and its business drivers during the first 25 years of integration.

In terms of territorial accessibility, Portugal triplicated its infrastructure in less than 10 years. More than 2.700km of main road were part of an ambitious plan to increase the connectivity within the country and reduce the adverse peripheral location of Portugal. As 2003, Portugal had a higher motorway density than EU15 but lower than countries with similar territorial areas like Belgium (INE, 2007).

Already recognized as one of the biggest obstacles for its development, Portugal made a huge effort in education. During the period of analysis, the investment in education as percentage of the GDP was not only higher than the European average but also higher than the benchmark countries – Spain and Italy- (Eurostat, 2015). By 2003 the expenditure reached 5.6% out of the total GDP and had a constant increase since 1995 as it can be seen in *Chart 2*.

Chart 2. Total expenditure in Education as % of GDP

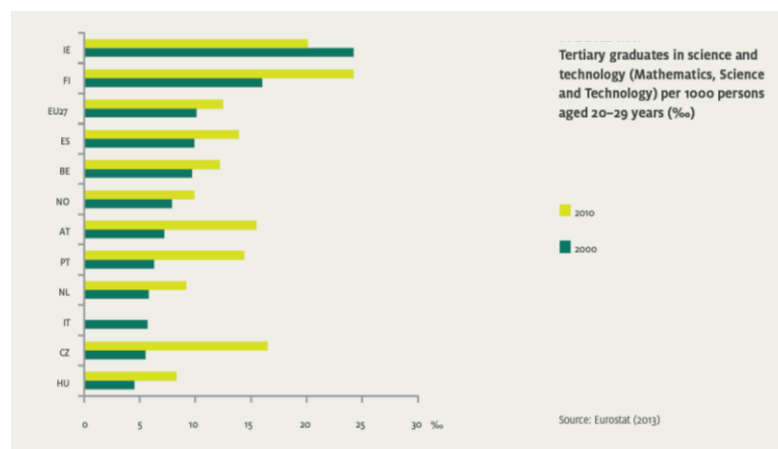


Source: INE, 2007

Though, the investment did not produce the expected impact in the educational system as the following indicators state. Despite of a positive variation of 30% on the total population between 25 to 64 years old having completed the secondary education, the global percentage remains low in comparison with the EU average – 26.5% vs 70%-. However, the situation is slightly reverted for the students aged 15-24 years old where Portugal had a remarkable growth in attending rate during the last decade of the XX century. Likewise, attending rate of 5 years children is higher than the rate registered in Europe by the end of last decade. This effort in the early childhood and primary education constitute an advantage in the long term.

It is worth noting that Portugal not only achieved but exceeded its goal regarding graduates in science and technological fields. This allowed Portugal to fill the gap in terms of knowledge both in the companies and in the national scientific labs. As it can be seen in *Chart 3*, Portugal has an outstanding relative growth in the last decade when is comparing with the listed European countries. The rising trend put it among countries like Spain and Austria and it is expected a multiplier effect to the innovation system (FCT, 2013).

Chart 3. Tertiary graduates in Science & Technology



Source: FCT, 2013

Before analyzing the R&D indicators to measure the growth of the system, it is important to understand how the NRIS evolved during this period and the several master plans executed in order

to get a better performance in innovation and scientific production. Although some of the recommendations cited in the previous chapter from multilateral organizations were adopted out of the time or were design but not effectively implemented i.e. the creation of a specific budget for R&D or an horizontal coordination body; the mismatch between investment and outcome is part of the process of building an NRIS almost from scratch as Portugal did.

Due to the structural funds and the first community program for R&D in Europe, R&D gained relevance in Portugal and became much more important than it was in the past. There were three main National Plans for Science and Technology and the NRIS was reframed twice during the period of analysis. The changes reflected the new size of the ecosystem, the new agents involved within the knowledge creation process and the dynamics derivate from their interaction. Given the current state of the R&D, the Government defined its intervention both on the supply side by creating legal instruments and infrastructure and on the demand side by promoting interaction between the agents of the system and even pushing the results by public procurement. These areas of intervention were the main drivers for the NRIS and the Technological plans.

By then, there was not a specific program for Research and Development but the first Community Support Framework Program – PEDIP- in 1988 defined seven subprograms where the different goals contributed to improve the competitiveness drivers. The subprograms related with R&D were: Infrastructure and technological capabilities, Professional Education, Investment, Financial Engineering and the Productiveness Mission. These subprograms represent the efforts on building innovative capabilities from the supply side as by the end of the program, more than 73 infrastructures were built for scientific and technological purposes (FCT, 2013). Following with this intervention side, the Scientific and Technological Research law was approved in 1988 and provided the system with specific legal instruments for the governance of R&D and its funding.

Therefore, the NRIS was adapted to respond to the PEDIP priorities and the fast evolution the ecosystem had due to the growth in funding from private and multilateral organizations and the increasing public investment in the targeted sectors: industry, health, agriculture and science. However, the system did not become faster and more effective as expected. The creation of the multiple decision making centers, the establishment of a specific budget for R&D and the focus on a competitive allocation of resources were remarkable implementations during the process but the vertical governance became an obstacle to get the agility the ecosystem needed by the time (FCT,2013).

As it can be seen in the Appendix 2, the NRIS grew in size and scope in comparison with its previous composition in 1974. One of the most noteworthy changes is the increasing number of enterprises involved, reaching 173 after having 3 in 1974. By 1992, as some fundamental factors were being transformed, R&D indicators started showing an outstanding evolution in several fields. Higher education consolidated its position as major player within the system reaching 43% out of the total expenditure in R&D and the Non-profit sector gained visibility as their expenditure in R&D represented 13% out of the National investment (FCT, 2013). The last achievement in terms of innovation during the 1990s was the study on cluster strategy for Portugal. Although it was only implemented in 2007 as a national policy, since the 1990s some industries decided to improve their value-chains by clusters and specialization.

During the next two decades, several plans and programs were designed and implemented to boost the R&D performance in Portugal. It was clear that Portugal was lagging in comparison with other countries and both Governments and multilateral organizations found in R&D the unique way to guarantee a competitive economy in a long-term. In 2001, the National Innovation System is defined and legally constituted in Portugal as consequence of the community framework derivate

of the Lisbon Strategy. Thus, the PROINOV program was approved as a vehicle to develop the system based on three main pillars: technology, innovation and knowledge. Likewise, the internationalization of the system was a priority and it helped to recognize and implement good-case practices from other countries and start collaborative projects with nations such as United Kingdom, USA, Spain and France.

In 2004, the PROINOV was replaced by the Strategic Initiative Knowledge and Innovation program which is the first plan that propose a policy approach focused on pushing the system towards a knowledge-based economy. Following the same approach but setting different goals according the evolution of system, the Technology Plan in 2005 recognized the failures of the innovation system and gave an active role to the Government to correct situations such as inefficiency in the resources allocation, lack of coordination between the different agents of the system and lack of an effective knowledge transference from Universities or Laboratories to Companies.

In 2007, Portugal decided to implement a robust policy on creating and developing clusters and technology hubs aligned with the field of science and the potential areas where there was a competitive advantage to be exploited. Between 2000 and 2012, there was not a significant change in the composition of the scientific production by area. It is important to remark the evolution Medical and Health Science had during the period, as both areas covered 80% of the Portuguese publications from 2005 to 2010(FCT, 2013). Likewise, Engineering and Technology and Natural Sciences kept the same relative weight within the total knowledge production – 20%.

Therefore, the NRIS in 2012 reflects a much more solid and deeper system. As it can be seen in Appendix 3, there is a clear focus on knowledge sharing and transference between the producers and the users at different levels. It is the weight achieved by the intermediary level with all the

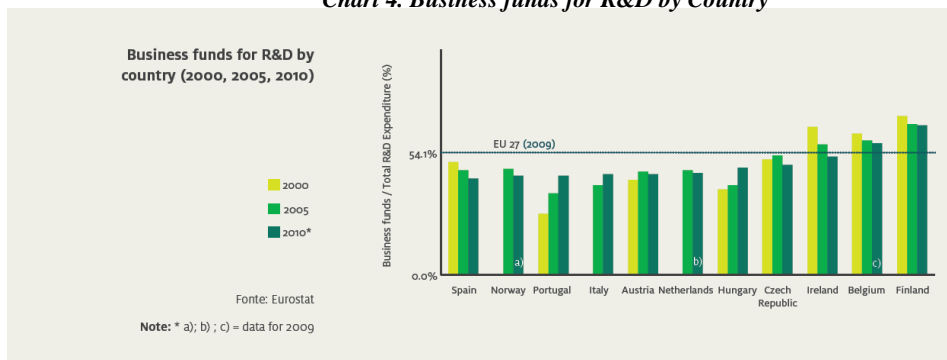
infrastructure related: 8 Technology Centers, 126 Centres and Institutes for R&D and more than 293 units for Funding the R&D. This shows an important achievement of the governmental efforts on the supply side of the system and partially solves the lack of interaction between producers and users. The consolidation of the Innovation Agency and the Science and Technology Foundation reframed the governance model and defined tools for a global analysis of the system (from policy design to post-implementation evaluation), functions not well established in the past.

The consolidation of the business drivers led to a better performance in R&D indicators given the interaction of the agents, the impact of the policies and the rationale behind the Regional Competitiveness Framework. Regarding the R&D Expenditure, by 2011 Portugal reached a total of 1.5 as percentage of the GDP. Portugal had the highest growth rate in comparison with the European Countries that belong to the Moderate Innovators group. This is probably one of the most important achievements for Portugal during this period, even if it is still far from the 3.5% of Finland. As it can be seen in *Appendix 4*, since the Technology Plan (2005) the R&D expenditure passed from 0.5 to 1.5 in 4 years. On the other side, the total R&D is higher in Portugal than in Spain or Italy. On the other side, Higher Education is the second biggest contributor to get this performance as by 2011 they had more than 60% of all researchers in the innovation system. Thus, the National goal for R&D Efforts was achieved one year before than planned (2009) but the financial crisis of 2008 has impacted this amount and the gap with the European parameter could not be closed.

By 1990, the R&D Expenditure by business funds represented 26.1% out of the total expenditure. As it was defined in the plans, increasing this indicator was a priority given the relevance and the multiplier effect of private investment in innovation. The maturity of the system, the achievements in R&D indicators such as infrastructure, human resources and internationalization provided

companies with the competitive environment to invest in R&D and accept their principal role within the ecosystem. By 2010, Business funds reached 44.1% out of the total R&D Expenditure with a notable evolution since 2005. Business as source for R&D is one of the best performing indicators when comparing with other European countries and the EU Average. Although the percentage remains below the EU average (54.1%), Portugal had the highest growth rate from 2000 to 2010 (69%), closing the gap with Spain and Norway. As it can be seen in *Chart 4*, Finland as innovator leader country leads this indicator with a slight reduction since 2000.

Chart 4. Business funds for R&D by Country



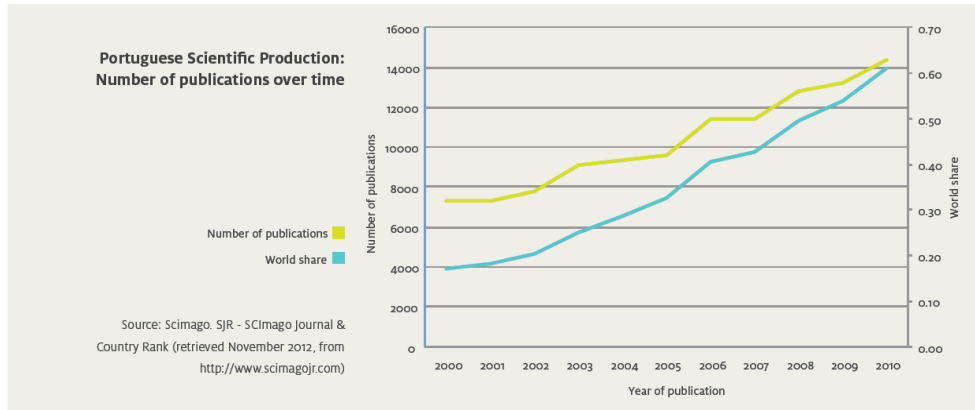
Source: FCT, 2013

Connectivity has increased its relevance within the European R&D system and Portugal has made a huge investment in its National Research & Education Network to be aligned with this Community effort. By 2010, more than 80% of Higher Education was covered by the platform and the available bandwidth had an exponential increase from 0.034 Gb/s to 20 Gb/s as a way to facilitate the international connectivity. As a result, the Portuguese system is connected with more than 400 million researchers from 8000 institutions in 40 countries.

These developments had enhanced Portuguese capabilities for Scientific and Technological knowledge production. Portugal increased 2.7 times its contribution to global production and publication in 15 years with an average annual growth rate of 14% (FCT, 2013). The outstanding performance in *Chart 5* is the result of a mature system, with more labour force focus on R&D at

every level of the system (Business, National Laboratories, Non-for profit organizations and Higher education) and a higher degree of internationalization.

Chart 5. Portuguese Scientific Production



Source: FCT, 2013

When comparing with other European Countries, the efforts during these two decades allowed Portugal to close the gap with Italy and Spain and get outstanding results in a relative perspective. However, in absolute values Portugal just climbed one position as contributor of Scientific Production in Europe and its publications represent 50% out of the total production of Finland. This distance could be explained as the productivity by researcher in Portugal was not improved during those decades and it remains as the third lowest in Europe.

Internationalization is critical for a successful innovation system since it allows to take advantage of potential synergies between countries and their scientific infrastructure. It is measured by looking at co-authored publications and since 2005 Portugal has increased and strengthened its network of production partners. The number of publications with any international collaboration had a relative growth of 200% between 2000 and 2010. By then, it represented 43% out of the total National production and there is a clear policy to keep participating in international projects. Part of the Community Framework for Innovation, several projects with different countries involved

have been executed during the last decade. Portugal has coordinated more than 20% of the projects in which it has participated so it is gaining international visibility within a globalized system.

Since 2005 the growth of international collaboration was exponential with Spain, USA, UK, Sweden and Germany. This collaboration is driven to some extent by the size of the country as it happens with countries such as Czech Republic. Spain is the country which Portugal has collaborated the most with during the last years given the Ibero-american context and the proximity in research areas such as Natural Sciences and Engineering and Technology.

Likewise, scientific production became specialized as the clustering strategy was established and consolidated throughout the main regions in Portugal: North, Lisbon, Alentejo, Algarve, Centre and Islands. Along the scientific production, the number of patents is one of the most tangible indicators for R&D worldwide. Between 2000 and 2010, Portugal increased its patent applications using the EPO by 233% and the annual growth rate is higher than its comparable countries in Europe. However, the levels of applications remain below the European average and the benchmark countries as consequence of asymmetries in the system and lack of cooperation between users and producers.

This lack of productivity and efficiency did not allow to close the gap in knowledge production with other European countries. There is no doubt on the poor performance of Portugal with less than 1500 citable publications per million inhabitants in 2010 (FCT, 2013) but when comparing

Chart 6. Number of Patent Application



with benchmark countries, it is important to take into account that the gap with Spain is not that big as it is with Finland and Portugal managed to overtake Italy.

This cannot be understood as the policies and programs in Portugal are going in the wrong way but it reflects a much more mature system in Finland and Norway and similarities with Spain in the way both countries have been implementing the NRIS. As it is going to be discussed later, once the system has well established fundamental factors and growing business drivers, the country is able to focus on which innovation mode suits better for the economy, design and implement smart specialization strategies and become a leader innovator country. Indeed, Finland and Norway started this phase earlier than Portugal and Spain and so the results. As consequence of higher number of graduates in science and technology fields, employment in KIS (Knowledge-intensive services) represented more than 50% out of total employment in the services sector (FCT, 2013). This indicator is aligned with the European parameters and the transition towards an economy mainly based in services.

Finally, the percentage of high technology exports is lower than the European average – 3% vs 15%- and reflects the Portuguese productive structure based on low-medium technology sectors with a small participation of high technology in Lisbon.

Thanks to the Community frameworks and the Operational Programs, Portugal has transformed its productive and innovation system since its adhesion to the European Union. As it was discussed through this chapter, the NRIS had an outstanding evolution and many indicators support this process. Portugal has increased its international visibility by leading R&D projects, the scientific publications by fulfilling the lack of Scientific and Technological personal in the country. Portugal is much more connected with global trends and the clusterization strategy in the beginnings of 1990s and the implementation in 2007 reflects the transition towards a knowledge society.

However, the NRIS was not effective with the resources allocation and the late adoption of the recommendations from the OECD became an obstacle to get better results and close the gap with the advanced European economies.

Nowadays, Portugal has a much more mature innovation system with several layers of agents that interact under the conditions created by the Government during the last years and funding by the private sector at its biggest participation: 44% out of the total R&D Expenditure.

4. Improving Competitiveness: The Road Ahead

The economic crisis, emerging economies and higher degrees of globalization are changing the way some countries define their strategies in order to sustain a competitive advantage and specialize their economies in high technology and knowledge intensive services. Developed economies have established fundamental factors and business drivers to move forward and reach a competitive stadium based on innovation. In this path, two main innovation models have been identified: Doing, Using and Interacting (DUI) and Science, Technology and Innovation (STI). Both models reflect the dynamics and productive systems of every country. The DUI model is based on experience and process innovation, which is relatively much more complicate to measure in comparison with innovations linked to patents and marketable products. On the other hand, the STI model contributes to a consolidation of scientific and technological knowledge, generating mechanism that can be applied to industries such as chemicals, pharmaceuticals, biotechnology and nanomaterials (Orkestra, 2014). Every model brings possible economic impacts, many scholars consider that the STI model has a stronger impact in productivity as its core is the product innovation by testing and discovering new ideas, properties, qualities and so on (Gonzalez-Pernia, 2011). On the other side, the DUI model works directly with interactions and experiences among the workers, users, producers so the mechanism or procedures can be improved. Although, in the

short term the DUI model has a stronger impact due to improvements in productivity; the STI has a stronger impact in the long-term (Orkestra, 2013).

As it can be seen in *Appendix 5*, Portugal has an outstanding record in innovation in services, supporting activities and design but its result in bringing new products to the market is below the EU average. It reflects that Portugal tends to a DUI model but leading innovators countries into the STI model. Nowadays, countries are looking for a balance between DUI and STI as both modes complement each other and accelerate the innovation process (Orkestra, 2013).

The regular pace the countries were moving towards the new stadium by, was affected by the economic crisis which changed the resource allocation priorities, generated several structural reforms in Portugal and a focus on competitiveness by lower production costs and exportations. Moreover, Europe recognized it was stuck in a paradox given its impossibility to translate all the efforts and investment in R&D into marketable products. Almost 30% of all the knowledge created in Europe was exploited by no-European companies (Navarro, 2013). Europe 2020 and Portugal 2020 established specific programs to overcome the paradox and consolidate an innovation union. With a regional approach, Compete 2020 is the Portuguese program to increase the national competitiveness and is focus on strengthening its clusterization process that started in 1990, promoting a smart specialization and the transference of knowledge from producers to users and investing in the supply side of the system to become an innovator leader.

Moreover, the program aims to re-organize the system and make it simpler so the agents can interact not only in an efficient way but also effective. The leadership assumed by the Public sector seeks to fund innovation projects that benefit SMEs and correct one of the market failures as biggest innovations belong to Enterprises with more than 240 employees and the expected multiplier effect is not happening. The smart specialization is providing competitive advantage to some regions in

Spain and it is expectable to get positive results with the way regions are working in Portugal (*see Appendix 6*).

Portugal was classified as Moderate Innovator and all its indicators are below the European average (European Union, 2015). Its innovative performance has been decreasing since 2010, however half of the indicators have started growing during the last years and show a relative advantage in scientific production, SME innovating in-house and international cooperation (European Union, 2015). On the other hand, achievements in education and human resources will boost R&D indicators. Hence, Portugal keeps focused on closing the gap with the most advanced economies in the European Union and the consolidation of the knowledge society will depend on the agility to coordinate the capabilities built during the last 30 years and allocate the available resources to find a DUI-STI well-balanced model and overcome the European Paradox.

5. Conclusions and recommendations

There is no doubt on the outstanding evolution of Portugal since its adhesion to the European Union. The convergence path has been interrupted by the consecutive crisis in the last 20 years, however, the last structural reforms sped up the state modernization and is gathering efforts for a bold step into the transition to a knowledge-based economy. The maturity of the system reflects a transition phase towards a new competitive stadium, however, the NRIS has challenges previously discussed such as the lack of interaction between private and public entities, the consolidation of a DUI model and the promotion of STI activities, the development of the smart specialization and cluster strategy and increase the patent application.

These are the main areas of improvement after analyzing the evolution of the NRIS since 1985 and the following recommendations are based on good case practices from the benchmark countries.

- ***Merging the DUI with the STI Model:*** As it was mentioned before, Portugal has a clear tendency into the DUI model of innovation. In different regions, even with higher level of manufacturing within their GDP composition, there is a consensus on finding a balance between both innovation modes as each one contributes in a specific way to get a better innovation performance. During the last years, Italy became a point of reference due to its ability to merge both models and the by promoting and supporting product innovation in SME in house and process innovation SME Marketing and organization. For this purpose, Technology Districts and High Technology poles were built in Italy and owned by multiple agents: researchers, companies, laboratories and funding organizations. Moreover, the system should be re-organized to adapt it to the new requirements and implement a simpler organization with decentralized decision making points as it happens in Italy.
- ***Smart specialization and Clustering:*** Cluster and Smart specialization (Europe 2020) seeks to modify some market failures. Portugal structure has been evolving during the last years and different fields of research per region is proof of this specialization. The smart specialization seeks to guarantee a competitive advantage. Spain has outstanding results in infrastructure, with a recognized network for innovation with producers and users. Spain has regional histories of success thanks to the early implementation of smart specialization, the active participation of the different stakeholders and the creation of clusters by industry and value-chain four years ago. Thus, Portugal should cooperate with Spain to get insights in the strategy definition and its implementation once it is adapted to Portuguese reality. (Orkestra, 2012)
- ***Patents Application – R&D Indicator-:*** Finland as a leader innovator is recognized for its capacity in patents application, patents revenues from abroad and how to allocate R&D resources in efficient activities. Improving this indicator requires a higher rate of scientific and technological personal,

a fluent interaction between users and producers and an effort in collaboration international could boost the Patent applications. On the other side, direct and indirect support for private R&D allowed Finland to organize its system by technology fields. Portugal should increase its participation in research projects in Europe and seeks the leadership of those projects. To sum up, the success of Finland in this matter is derivate of a well-connected system with a high level of cooperation.

- **Public – Private collaboration:** As it was seen before, during many years the NIRS was driven by the Government. However, the private initiative is key to establish an exceptional innovation system. In this case, Norway and its Nordic model provides us with interesting cases based on how to increase public-private co-publications, the engagement the stakeholders and promote venture capital investments with tax benefits (AERU, 2010) However, the Government should increase its participation within the R&D Expenditure since it is needed to modify the market failure and support SME's in their product innovation processes.

As soon as these recommendations are taking into account, the ideas proposed by the OECD should be adapted and introduced to the system. The NRSI should track and evaluate the different programs they have, however, it does not happen due to the lack of interest in measuring the efficiency of the investment. In conclusion, Portugal is going back to the convergence path and both the fundamental factors and the development of specific policies that impact the competitiveness drivers have experienced a remarkable evolution. As other EU Member States, Portugal is struggling with the European paradox and the asymmetries of the NRIS, however, a much more independent coordination body, the consolidation of a Budget for R&D, a clear focus on post-evaluation and *Compete 2020* will boost the transition towards a knowledge-based economy.

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